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⑤④ **Medicament inhalation device.**

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**FR-A-2 228 499**  
**FR-A-2 257 351**  
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## Descripti n

### Background and prior art

The invention is directed to an inhalation device comprising a medicament chamber capable of storing finely-divided medicament therein, an air inhalation chamber, and a substantially cylindrical medicament delivery member communicating between said medicament chamber and said air inhalation chamber, said medicament chamber having a downwardly directed funnel-shaped bottom wall with a bottom opening therein and having also an upwardly extending side wall from said bottom wall with the closed top to define said chamber, said air inhalation chamber having a longitudinally extending outer wall having a top opening therein and two opposing ends, a side air inlet means formed in a closed end wall at the first of said ends and a mouthpiece air outlet means having a transverse screen associated therewith located at the second of said ends opposite to said air inlet means, said medicament delivery member having a cavity of predetermined volume therein with an opening therefor and being vertically rotatable between a first position wherein said cavity opening is vertically aligned with said bottom opening of said medicament chamber so as to fill said cavity with a predetermined dose of medicament from said medicament chamber and a second position wherein said cavity opening is vertically aligned with said top opening of said air inhalation chamber so as to enable the predetermined dose of medicament to pass into said inhalation chamber, whereby inhalation of air from said air inlet means into said air inhalation chamber and from said mouthpiece air outlet means effects movement of said predetermined dose of medicament through said air inhalation chamber and from said mouthpiece.

Hypersensitive individuals undergo an altered state as a result of contact with the antigens from an allergen, leading to the formation of antibodies to the allergen. Subsequent contact with one of those antigens or a structurally similar substance can evoke in an allergic individual a pathological reaction, due to the presence of such antibodies. A prominent manifestation includes bronchial asthma, characterized by obstruction of the lung airway passages.

In order to reduce these undesirable allergic responses, various medicaments which have an antiallergic characteristic have been administered to patients.

It has been firmly established that the optimal route of medicament administration to provide therapeutic relief against such allergic response is by inhalation, which provides local administration to the lung airway lumen. Inhalation provides convenience and speed of action and often requires only a small dose of the pharmacologically active agent.

One type of inhalation device involves the use of conventional pressurized aerosol canisters. Some patients, however, find it difficult to synchronize inhalation through the mouth with activation of

the canister. Substances used as propellants in such aerosols may include fluorocarbons, which are safe when inhaled in small quantities, but may predispose individuals to ventricular arrhythmias if inhaler usage is excessive.

Various inhalation devices have been proposed and used which are capable of delivering dry powder medicaments into the patients' lungs. Typical of such inhalation devices are those described in U.S. Patent Nos. 3,507,277; 3,635,219; 3,669, 113 and 3,870,046.

Many inhalation devices rely upon the motion of inhaled air to cause dispersion of the medicament into the air being inhaled. For example, U.S. Patent No. 4,200,099 to Guenzel et al., describes such a device wherein a venturi effect is utilized to effect efficient dispersion and inhalation. Similarly, U.S. Patent No. 4,240,418 discloses use of venturi-shaped chambers. However, many of such prior art devices are susceptible to clogging, are complicated and are difficult to operate. Drug delivery by inhalation requires a device which is relatively simple in construction, inexpensive and easy to use by young and older individuals, is compact in size, and also capable of delivering a metered dose of various sized particles. There is a need in the allergy field for such a simplified and efficient inhalation device.

Other prior art devices are disclosed in European Patent Publication No. 79 478 and French Patent No. 2 435 254. In the former device the medicament powder to be distributed was positioned on a ledge or collector in the inhalation chamber. It had the disadvantage that the air flow used for distribution passed over the ledge in a manner parallel to the powder which was an inefficient means for distribution of the powder in such air flow. In the latter patent an attempt was made to direct the distribution of air flow generally toward the medicament powder, but it still required a separate mechanical deflector to specifically have the air flow impinge on the powder.

### Summary of the invention

The present invention is directed to an inhalation device as described in the introduction of the specification. The improvement of which comprises that said side air inlet means comprises a passage extending through said end wall at an oblique angle with respect to the plane of orientation of said first opposed end, the longitudinal axis of said passage being positioned so as to intersect the outer wall of said air inhalation chamber at a point directly beneath and opposite to said top opening therein.

Further improvement and optional features are disclosed in the subclaims.

### Description of the drawings

Figure 1 is a vertical cross-sectional view of the medicament inhalation device of the present invention;

Figure 2 is a front elevational view of the apparatus of Figure 1 taken along Line 2—2;

Figure 3 is a vertical cross-sectional view of a

portion of the apparatus of Figure 1 taken along Line 3—3 with the medicament delivery member rotated 180 degrees from the position of Figure 1;

Figure 4 is a vertical cross-sectional view similar to Figure 3 with the medicament delivery member removed;

Figure 5 is an end view of a portion of the apparatus taken along Line 5—5 of Figure 4;

Figure 6 is a side elevational view of the medicament delivery member;

Figure 7 is an end view of the medicament delivery member taken along Line 7—7 of Figure 6; and

Figure 8 is a side elevational view of the medicament delivery member rotated 90 degrees from the position of Figure 6.

#### Description of the invention

As shown in Figure 1, the illustrated embodiment of the present invention comprises a medicament inhalation device 10 having a medicament chamber 11, an air inhalation chamber 12, and a substantially cylindrical, metered dose medicament delivery member 13. Medicament chamber 11 is generally vertically cylindrical in shape and is formed with sidewall 14 and a downwardly directed funnel-shaped bottom wall portion 15 having a bottom opening 16 therein communicating with a vertical passage 17. Chamber 11 is closed at the top portion 18. Air inhalation chamber 12 has a horizontally longitudinally extending outer wall 19 with a top opening 20 therein communicating with vertical passage 17. Air inhalation chamber 12 has a first closed end wall 21 and a second open end 22 located opposite to said first end wall 21. First end wall 21 has a side air inlet means formed by a passage 23 extending through the end wall 21 at an oblique angle with respect to the plane of orientation of end wall 21. The longitudinal axis 24 of passage 23 is positioned so as to intersect the outer wall 19 at a point 25 directly beneath and opposite to the top opening 20 of chamber 12. The outer end of passage 23 can communicate with a recess 31 located in first end wall 21. As shown in Figures 3 and 4, chamber 12 has an elliptical cross-section shape.

Chamber 12 is conveniently formed in a generally L-shaped single member 34 having the horizontally positioned wall 19 and a vertical portion 32 having the funnel-shaped portion 15 and vertical passage 17 formed therein. Transverse horizontal passage 33 having a circular cross-section is formed in member 34 normal to vertical passage 17 and the longitudinal axis of chamber 12. As shown in Figure 4, passage 33 has a constriction 35 located therein near one end thereof. As shown in Figure 5, constriction 35 has two radius ribs 46 located on the outer surface thereof diametrically from each other. As shown in Figure 4, constriction 35 also has two similar radius ribs 56 located on the opposite side from ribs 46. Vertical portion 32 of member 34 has external threads 36. The medicament chamber 11 is conveniently formed by placing cylindrical

member 55 having a closed end 18 and internal threads 37 in mating relationship with the threads 36 of vertical portion 32 of member 34. It is understood that member 55 can alternatively be attached to member 34 by other means, such as interlocking snap-on devices. Vertical portion 32 has a horizontal extension 38 with a lower detent 39 depending therefrom.

A mouthpiece air-outlet member 26 is placed over the open end 22 of chamber 12 of member 34. Member 26 has a horizontally longitudinally extending wall 40 surrounding an internal stepped outlet passage 29. This stepped passage has a first portion 41 having internal dimensions slightly larger than those of the outer wall 19 of chamber 12 so that it can conveniently slip over wall 19. The stepped passage has a second portion 42 having internal dimensions substantially the same as those of chamber 12 and open end 22. Step 43 is located at the junction between first portion 41 and second portion 42. Transverse screen 27 having a plurality of openings 28 therein is located in first portion 41 at step 43. Screen 27 is intended to break up clumps of medicament particles. Each of said openings 28 has a cross-sectional dimension slightly larger than the corresponding dimension of the largest clump of medicament particles intended to pass through chamber 12. The outlet portion 30 of mouthpiece member 26 is externally tapered so as to conveniently fit into a human mouth. As shown in Figure 2, mouthpiece member 26 and screen 27 have a generally elliptical cross-sectional shape which corresponds to the shape of chamber 12. Member 26 has an external detent 44 projecting upward from wall 40 near the end of member 26 opposite from outlet portion 30. Member 26 preferably has a projection 45 of generally circular shape extending upward from wall 40. This projection prevents member 26 from being swallowed by a patient if it is detached from the device 10 for any reason. In the assembly of device 10, member 26 is slipped over wall 19 and pushed until detent 44 passes under and is engaged by detent 39. Screen 27 then covers open end 22 of chamber 12.

Metered dose medicament delivery member 13 is shown in Figures 6, 7 and 8. Member 13 has a main cylindrical portion 47 with an elongated slot cavity 48 having an opening 49 thereof formed therein. Cavity 48 has a predetermined volume. The elongated axis of the cavity 48 is parallel to the longitudinal axis of portion 47. Member 13 has an axial extension 50 with a reduced cross-sectional portion 51 located at one end thereof. A transverse slot 52 is formed in member 13 and extends longitudinally through extension 50 and into cylindrical portion 47. At the other end of member 13 opposite to extension 50 there is an arm 53 projecting radially from member 13. On one side of arm 53 is an indicator marker, such as arrow 54. In the assembly of device 10, member 13 is placed into passage 33 of member 34 and pushed inward until extension 50 passes through constriction 35 and constriction 35 mates

against reduced portion 51. This is shown in Figure 3. When arm 53 is in the position shown in Figure 3, the opening 49 of cavity 48 is vertically aligned with opening 20 of chamber 12. In this position the ribs 46 and 56 snap into slot 52 and arrow 54 is aligned with an indicator (not shown) on the outer surface of member 34. When arm 53 is vertically rotated to a position 180 degrees from that shown in Figure 3, the opening 49 of cavity 48 will be in the position shown in Figure 1 vertically aligned with the bottom opening 16 of medicament chamber 11. In this position the ribs 46 and 56 will again snap into slot 52 and the arrow 54 on arm 53 will be aligned with another indicator (not shown) on the outer surface of member 34. The cross-sectional dimensions of opening 16 and passage 17 are preferably the same as those of opening 49 of cavity 48.

The member 34, mouthpiece 26, member 55 and screen 27 are preferably formed from suitable rigid organoplastic materials, such as polystyrene, polyethylene, polypropylene, styrene-acrylonitrile copolymers, polycarbonate, acetal copolymers, nitrile-acrylonitrile-styrene copolymers, polymethylpentene, polyacrylate, polymethacrylate and the like. Member 34, mouthpiece 26 and screen 27 are preferably formed from high impact polystyrene. Member 55 is preferably optically transparent. Member 13 is preferably formed from a softer organoplastic, such as the polyamides known as nylon.

In the manufacture of the device of this invention, member 55 is filled with the desired finely-divided medicament. Member 34 is inverted from the position shown in Figure 1 while member 55 containing the medicament in chamber 11 is screwed onto the threads 36 of member 34. The device is then held in the position shown in Figure 1. Arm 53 is rotated to an upwardly extending position which places cavity 48 in the first position shown in Figure 1 so as to fill cavity 48 with a predetermined dose of medicament from chamber 11. It is preferable to tap the device to enable complete flow of medicament into cavity 48. Arm 53 is then vertically rotated 180 degrees to the second position shown in Figure 3. Cavity 48 is now vertically aligned with the top opening 20 of chamber 12 so as to enable the predetermined dose of medicament to drop into inhalation chamber 12 where it is deposited on the outer wall 19 directly beneath opening 20. It is also preferable to tap the device to enable complete removal of medicament from cavity 48. A patient then places his mouth over the mouthpiece 26 and inhales. The resulting inhalation of air from air inlet means 23 causes the air stream to strike the medicament on the bottom of chamber 12 causing such medicament to become suspended in the air stream. The suspended dose of medicament then moves through the screen 27 and out of the mouthpiece into the respiratory tract of the patient.

The finely-divided medicaments used in the device of the present invention can range from about 0.5 to 5 microns in particle size as a preferred range for efficient administration to the lung

airway lumen. The size of the cavity 48 in delivery member 13 will be dependent upon the desired dose of the particular medicament. It is intended that chamber 11 hold about 2—10 g. of medicament so that the device can be used to deliver about 200 doses. Different color coded delivery members 13 could be employed to designate different dose cavity sizes. Also different sizes of member 55 can be used for various storage capacities.

When the device of the present invention is not being used by a patient, removable cover means (not shown) can fit into recess 31 and the inlet of mouthpiece 26 to seal and protect them.

### Claims

1. An inhalation device having, in combination, a medicament chamber (11) capable of storing finely-divided medicament therein, an air inhalation chamber (12), and a substantially cylindrical medicament delivery member (13) communicating between said medicament chamber (11) and said air inhalation chamber (12), said medicament chamber (11) having a downwardly directed funnel-shaped bottom wall (15) having a bottom opening (16) therein and having an upwardly extending side wall (14) from said bottom wall (15) with a closed top (18) to define said chamber (11), said air inhalation chamber (12) having a longitudinally extending outer wall (19) having a top opening (20) therein and two opposing ends (21, 22), a side air inlet means formed in a closed end wall (21) at the first of said ends and a mouthpiece air outlet means (26) having a transverse screen (27) associated therewith located at the second of said ends opposite to said air inlet means, said medicament delivery member (13) having a cavity (48) of predetermined volume therein with an opening (49) therefor and being vertically rotatable between a first position wherein said cavity opening (49) is vertically aligned with said bottom opening (16) of said medicament chamber (11) so as to fill said cavity (48) with a predetermined dose of medicament from said medicament chamber (11) and a second position wherein said cavity opening (49) is vertically aligned with said top opening (20) of said air inhalation chamber (12) so as to enable the predetermined dose of medicament to pass into said inhalation chamber (12), whereby inhalation of air from said air inlet means (23) into said air inhalation chamber (12) and from said mouthpiece air outlet means (26) effects movement of said predetermined dose of medicament through said air inhalation chamber (12) and from said mouthpiece (26), characterized in that said side air inlet means comprises a passage (23) extending through said end wall (21) at an oblique angle with respect to the plane of orientation of said first opposed end (21), the longitudinal axis (24) of said passage (23) being positioned so as to intersect the outer wall (19) of said air inhalation chamber (12) at a point (25) directly beneath and opposite to said top opening (20) therein.

2. An inhalation device according to Claim 1,

wherein the cavity (48) of the medicament delivery member (13) is in the form of an elongated slot (8) extending in the axial direction of the medicament delivery member (13) and transversely of the axis of the inhalation chamber (12) and wherein the bottom opening (16) of the medicament chamber (11) has cross-sectional dimensions corresponding to those of the cavity (48) of the medicament delivery member (13).

3. An inhalation device according to Claim 1, wherein the air inhalation chamber (12) and the mouthpiece air outlet means (26) both have an elliptical transverse cross-section.

4. An inhalation means according to Claim 1 having external means (54) for indicating the position of the cavity (48) in the medicament delivery member (13).

#### Patentansprüche

1. Inhalationsgerät mit einer Arzneimittelkammer (11) zur Aufnahme eines feinverteilten Medikaments, einer Luftinhalationskammer (12) und einem im wesentlichen zylindrischen Arzneimittelauslaßteil (13), das zwischen der Arzneimittelkammer (11) und der Luftinhalationskammer (12) eine Verbindung herstellt, wobei die Arzneimittelkammer (11) durch eine nach unten gerichtete trichterförmige, untere Wand (15) mit einer unteren Öffnung (16) sowie durch eine von dieser unteren Wand (15) nach oben sich erstreckende Seitenwand (14) mit einer geschlossenen Decke (18) gebildet wird, und die Luftinhalationskammer (12) eine in Längsrichtung sich erstreckende äußere Wand (19) mit einer Deckenöffnung (20) und zwei gegenüberliegende Enden (21, 22) aufweist, in denen ein seitlicher Lufteinlaßteil in einer geschlossenen Endwand (21) an einem der beiden Enden (21, 22) und ein Luftauslaß-Mundstückteil (26) mit einem damit verbundenen Siebnetz (27) an dem anderen der beiden Enden gegenüber dem Lufteinlaßteil angeordnet sind, wobei ferner das Arzneimittelauslaßteil (13) einen Hohlraum (48) mit vorbestimmten Volumen mit einer Öffnung (49) aufweist und vertikal derart zwischen zwei Stellungen drehbar ist, daß in der ersten Stellung die Hohlraumöffnung (49) mit der unteren Öffnung (16) der Arzneimittelkammer (11) in senkrechter Richtung verbunden ist, um den Hohlraum (48) mit einer vorbestimmten Dosis eines Arzneimittels aus der Arzneimittelkammer (11) zu füllen, und in der zweiten Stellung die Hohlraumöffnung (49) mit der Deckenöffnung (20) der Luftinhalationskammer (12) in senkrechter Richtung verbunden ist, um die vorbestimmte Dosis eines Medikaments in die Inhalationskammer (12) eintreten zu lassen, und wobei die Inhalation von Luft aus dem Lufteinlaßteil in die Luftinhalationskammer (12) und aus dem Luftauslaß-Mundstückteil (26) heraus die Bewegung der vorbestimmten Dosis eines Medikaments durch die Luftinhalationskammer (12) und aus dem Mundstück (26) heraus bewirkt, dadurch gekennzeichnet, daß das Lufteinlaßteil einen Durchgang (23) aufweist, das sich durch die Endwand (21)

unter einem schiefen Winkel bezüglich der Orientierungsebene der genannten ersten Gegenwand (21) erstreckt, wobei die Längsachse (24) des Durchganges (23) so angeordnet ist, daß sie die Außenwand (19) der Luftinhalationskammer (12) an einem Punkt (25) schneidet, der direkt unterhalb und gegenüber der genannten Deckenöffnung (20) liegt.

2. Inhalationsgerät gemäß Anspruch 1, dadurch gekennzeichnet, daß der Hohlraum (48) des Arzneimittelauslaßteils (13) in Form eines verlängerten Spaltes (8) ausgebildet ist, der sich in axialer Richtung des Arzneimittelauslaßteils (13) und quer zur Achse der Inhalationskammer (12) erstreckt, und daß die untere Öffnung (16) der Arzneimittelkammer (11) Querschnittsabmessungen aufweist, die denen des Hohlraums (48) des Arzneimittelauslaßteils (13) entsprechen.

3. Inhalationsgerät gemäß Anspruch 1, dadurch gekennzeichnet, daß die Luftinhalationskammer (12) und das Luftauslaß-Mundstückteil (26) beide eine elliptische Querschnittsfläche aufweisen.

4. Inhalationsgerät gemäß Anspruch 1, dadurch gekennzeichnet, daß es Außenteile (54) aufweist, um die Stellung des Hohlraums (48) im Arzneimittelauslaßteil (13) anzuzeigen.

#### Revendications

1. Dispositif d'inhalation comportant, en combinaison, une chambre (11) à médicament pouvant emmagasiner un médicament finement divisé, une chambre (12) d'inhalation d'air et un élément sensiblement cylindrique (13) de distribution de médicament communiquant entre ladite chambre (11) à médicament et ladite chambre (12) d'inhalation d'air, ladite chambre (11) à médicament ayant un fond (15) en forme d'entonnoir dirigé vers le bas qui présente une ouverture inférieure (16), et ayant une paroi latérale (14) s'étendant vers le haut à partir dudit fond (15), et un dessus fermé (18) pour définir ladite chambre (11), ladite chambre (12) d'inhalation d'air ayant une paroi extérieure (19) s'étendant longitudinalement qui présente une ouverture supérieure (20) et deux extrémités opposées (21, 22), des moyens d'entrée latérale d'air formés dans une paroi extrême fermée (21) à la première desdites extrémités et des moyens de sortie d'air (26) à embout buccal auxquels est associé un tamis transversal (27) disposé à la seconde desdites extrémités, opposée auxdits moyens d'entrée d'air ledit élément (13) de distribution de médicament renfermant une cavité (48) d'un volume prédéterminé, pour laquelle est prévue une ouverture (49) et pouvant tourner verticalement entre une première position dans laquelle ladite ouverture (49) de la cavité est alignée verticalement avec ladite ouverture inférieure (16) de ladite chambre (11) à médicament afin de remplir ladite cavité (48) d'une dose prédéterminée de médicament à partir de ladite chambre (11) à médicament et une seconde position dans laquelle ladite ouverture (49) de la cavité est alignée verticalement avec ladite ouverture supérieure (20) de ladite chambre

(12) d'inhalation d'air afin de permettre le passage de la dose prédéterminée de médicament dans ladite chambre (12) d'inhalation, de manière qu'une inhalation d'air à partir desdits moyens (23), d'entrée d'air dans ladite chambre (12) d'inhalation d'air et à partir desdits moyens (26) de sortie d'air à embout buccal provoque un mouvement de ladite dose prédéterminée de médicament à travers ladite chambre (12) d'inhalation d'air et à partir dudit embout buccal (26), caractérisé en ce que lesdits moyens d'entrée latérale d'air comprennent un passage (23) s'étendant à travers ladite paroi extrême (21) sous un angle d'inclinaison par rapport au plan de l'orientation de ladite première extrémité opposée (21), l'axe longitudinal (24) dudit passage (23) étant situé de façon à couper la paroi extérieure (19) de ladite chambre (12) d'inhalation d'air en un point (25) situé directement au-dessous de et opposé à ladite ouverture supérieure (20) de cette chambre.

2. Dispositif d'inhalation selon la revendication 1, dans lequel la cavité (48) de l'élément (13) de distribution de médicament se présente sous la forme d'une fente allongée (8) s'étendant dans la direction axiale de l'élément (13) de distribution de médicament et transversalement à l'axe de la chambre (12) d'inhalation, et dans lequel l'ouverture inférieure (16) de la chambre (11) d'un médicament présente, en section transversale, des dimensions correspondant à celles de la cavité (48) de l'élément (13) de distribution de médicament.

3. Dispositif d'inhalation selon la revendication 1, dans lequel la chambre (12) d'inhalation d'air et les moyens (26) de sortie d'air à embout buccal ont tous deux une section transversale elliptique.

4. Moyen d'inhalation selon la revendication 1, comportant des moyens extérieurs (54) destinés à indiquer la position de la cavité (48) dans l'élément (13) de distribution de médicament.

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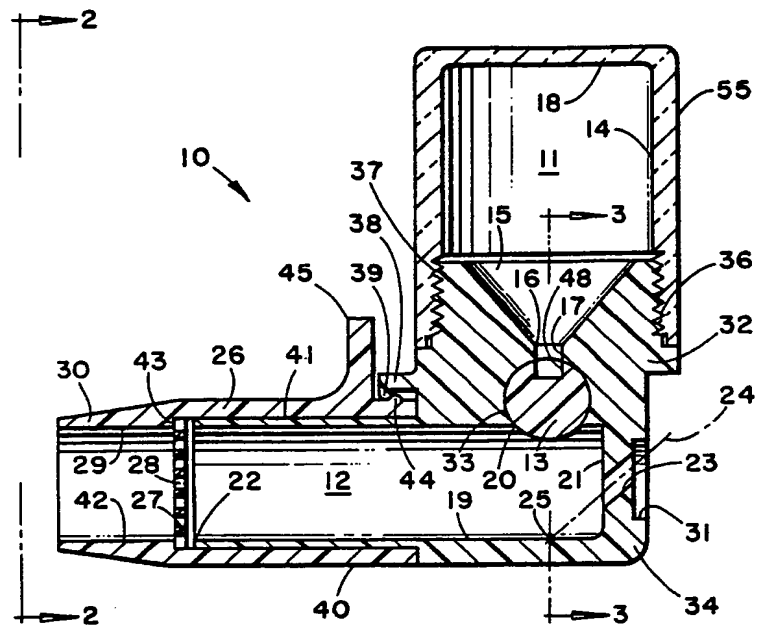


FIG. 1

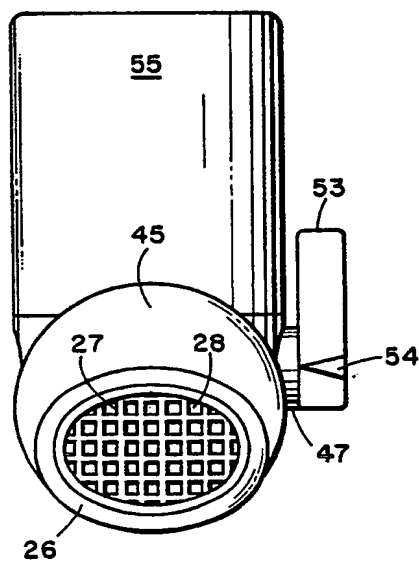


FIG. 2

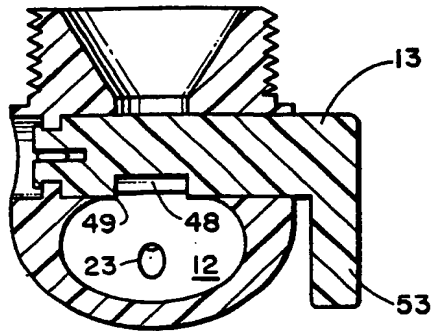


FIG. 3

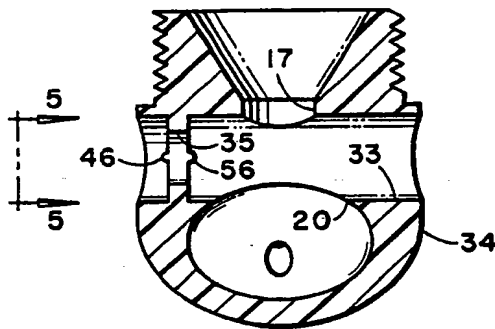


FIG. 4

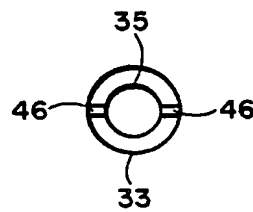


FIG. 5



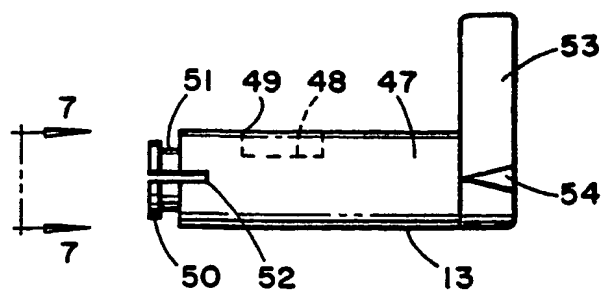


FIG. 6

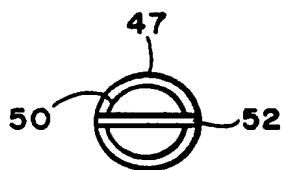


FIG. 7

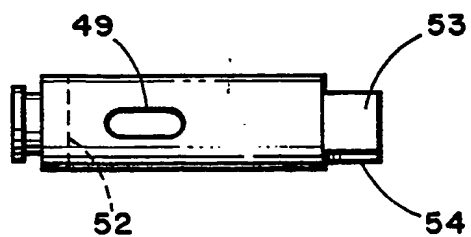


FIG. 8